METHOD OF MANUFACTURING MOLDED COMPONENTS

This application claims priority from U.S. provisional patent application Serial No. 60/416,995, entitled METHOD OF MANUFACTURING MOLDED COMPONENTS, filed October 8, 2002.

I. Background of the Invention

A. Field of Invention

This invention pertains to apparatuses and methods in manufacturing injection-molded components as well as apparatuses and methods in manufacturing vehicle light fixtures. More specifically, this invention pertains to apparatuses and methods concerning the injection molding process for lawn tractor hoods and to apparatuses and methods related to head lights mounted in lawn tractor hoods.

B. Description of the Related Art

The process of injection molding used to form molded components is well known in the art. In addition, it is well known that two or more mold components are typically used in the process of injection molding. More specifically, it is well known in the art that three or more molds or tools are required in the process of injection molding complex components. Such combinations of tools generally work well for their intended purpose. However, the use of multiple molds increases the costs involved in manufacturing such complex components.

An example of a complex component is illustrated in FIGURES 1-5. As can be observed from FIGURES 1-2, both an upper and lower mold are required to form the hood 10 there illustrated. In addition to the upper and lower mold, a third mold component or tool is also required in order to form the parabolic shape 12 (seen best in FIGURES 2-3) at the front of the hood (necessary for the headlight compartments). Once the upper and lower mold tools are in place to form the hood, the third mold tool or component is then inserted into the front to form

the parabolic shape. The use of a three-component mold system is essential for this type of part because the formation of the parabolic shaped cavity would prevent the removal of the upper and lower mold pieces in a two-component system. The more mold-components required for the process, the more expensive the process becomes. Therefore, one disadvantage of the prior art is the use of such third components (or more than three components) in injection molding processes.

Another disadvantage of the known processes is related to the method of attaching the reflecting material into the parabolic shaped cavity at the front of the hood. The purpose of the reflective material is to increase the illumination of the headlights. This material is a flexible material having one side with a shiny reflecting material and a second side with an adhesive material used to adhere the reflecting material to the parabola shape cavity at the front of the hood. As can be seen by the deformation illustrated in FIGURES 4 and 5, the material is difficult to attach. In addition, this process and the time required to attach this material does not lend itself to an efficient manufacturing process. This too increases the cost of the manufacturing process.

The present invention provides methods and apparatuses for forming a complex molded component (such as a hood) using only two mold portions or tools. The difficulties inherent in the related art are therefore overcome in a way that is simple and efficient, while providing better and more advantageous overall results.

II. Summary of the Invention

The present invention addresses the disadvantages mentioned above. First, the development of a new more rigid type of reflective material allows the manufacturer to attach the material without the use of an adhesive while still maintaining the required parabola shape. This development further allows the use of a two-piece mold to form the tractor hood since the parabola shape cavity molded into the front of the hood is no longer required.

Still other benefits and advantages of the invention will become apparent to those skilled in the art to which it pertains upon a reading and understanding of the following detailed specification.

III. Brief Description of the Drawings

The invention may take physical form in certain parts and arrangement of parts, a preferred embodiment of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof and wherein:

FIGURE 1 is a side view of a lawn tractor hood made using the prior art method with a three part mold.

FIGURE 2 is a bottom view of the prior art hood of FIGURE 1.

FIGURE 3 is a perspective side view of the bottom surface of the prior art hood of FIGURE 1 showing the parabola shaped cavity.

FIGURE 4 is a front view of the prior art hood of FIGURE 1.

FIGURE 5 is a side view of the parabola shaped cavity located at the front of the prior art hood of FIGURE 1.

FIGURE 6 is a top view of the inventive reflective material shown in a flat orientation prior to being formed into a parabolic shape.

FIGURE 7 is a top view of the inventive reflective material of FIGURE 6 after the material has been formed into a parabolic shape.

FIGURE 8 is a side view of the inventive reflective material of FIGURE 7.

FIGURE 9 is back view of the inventive reflective material of FIGURE 6 in a pre-parabolic shape.

FIGURE 10 is a side view of the inventive reflective material of FIGURE 9 after the material has been formed into a parabolic shape.

FIGURE 11 shows a front view of the hood of the present invention without the insertion of the reflective material.

FIGURE 12 shows a front view of the hood of the present invention with the insertion of the reflective material.

FIGURE 13 shows the inside view of the front of the hood of the present invention without the reflective material.

FIGURE 14 shows an inside view of the front of the hood of the present invention with the insertion of the reflective material.

FIGURE 15 shows a side view of the mold of the present invention in the open position.

FIGURE 16 shows a side view similar to that in FIGURE 15 but showing the mold of the present invention in the closed position.

IV. Description of the Preferred Embodiment

The present invention provides for a molding process that utilizes only two mold components (or tools) capable of producing a relatively large component having complex features. This process is best described by comparing the method of the prior art versus the method of the present invention. Referring to the prior art in FIGURES 1-5, a complex molded component, more specifically, a lawn tractor hood 10 formed by a three-piece mold is shown. It should be noted that the present invention can be used for other types of complex molded components used with sound engineering judgment. The lawn mower hood 10 used here is for the purpose of illustration. FIGURES 2, 3 and 5 specifically show the parabolic shaped cavity 12 located at the front of the hood 10. The purpose of this cavity 12 is to create a parabolic shaped surface upon which a reflective material 14 can be adhesively placed. The parabolic shape is well known in the field of headlights to provide the proper light reflective properties for the headlights 16. (Since these light reflective properties are well known in the art, further detail will not be provided here.) However, the formation of the parabolic shaped cavity 12 requires the use of a three-mold component in the injection molding process. Therefore, the first aspect of this invention is a method of placing a reflective material over the light bulbs and into the front of the hood wherein the reflective material maintains a parabolic shape without the need for a parabolic shaped cavity formed in the front of the hood to support the reflective material.

The inventive reflective material 20 is shown in FIGURES 6-10. The reflective material 20 has a certain degree of flexibility to allow the installer the ability to bend the material and insert it into the front of the hood 30. The resulting hood of the present invention is shown in FIGURES 11-16. The reflective material 20 also has a certain amount of rigidity that allows it to maintain a parabolic shape 22 after it has been installed in the hood 30. The front side 24 of the material 20 preferably has a mirror-like material or surface designed to increase the illumination of the headlights 32 of the vehicle. The back 26 of the material is preferably opaque. The reflective material may have a pair of holes 28. Each hole 28 receives one head light as will be described below.

FIGURES 11-14 show the preferred embodiment with and without the reflective material 20 of the present invention inserted. FIGURES 11 and 13 illustrate that the parabolic shaped cavity 12 of FIGURES 1-5 is no longer required to place the reflective material 20 over the headlights 32. In the preferred embodiment, the headlights 32 are simply inserted through holes 34 in the headlight flange 38 as illustrated in FIGURES 12 and 14. The process of attaching and connecting the headlights onto a headlight flange 38 can be by any known process chosen with sound engineering judgment. Options include using a pressure fit, a snap fit, threads permitting the headlights to be screwed into the flange 38, and the use of a "plugged in" connection with a receptacle. In the preferred embodiment, the headlight 32 is first placed within a socket (not shown) that has tabs. The socket is then extended into the hole 34 and turned. This causes the tabs to lock the headlight 32 onto the flange 38. This embodiment is also known in the art and thus will not be described in detail.

With continuing reference to FIGURES 11-14, the reflective material 20 is inserted into a C-shaped open cavity 36 at the front of the hood 100. The holes 28 in the reflective material 20 are placed over the headlights 32 and the reflective material 20 is pushed back toward the headlight flange 38 so that the headlights 32 protrude through the holes 28 in the reflective material 20. The installer continues to push the reflective material 20 back until the back 26 of the reflective material 20 is pressed against the headlight flange 38. Finally, the bottom portion 40 of the reflective material 20 is attached into place at the bottom 42 of the open cavity 36 at the front of the hood 100. The bottom portion 40 of the reflective material 20 can be attached to the bottom 42 of the open cavity 36 by clamping, securing with tabs, inserting the material into a slot or by any means chosen with sound engineering judgment. The reflective material 20 is able to maintain its parabolic shape 22 due to the rigidity of the material. One advantage of this method is the simplicity and ease of placing the reflective material 20 into the open cavity 36 at the front 100 of the hood 30. This process reduces manufacturing costs, which in turn can be passed on to the consumer. Yet another advantage of this process is the elimination of the deformation in the reflective material 14 previously mentioned in the prior art above and illustrated in FIGURES 4

and 5. Finally, a third advantage of this method is the elimination of the parabolic shaped cavity 12 required in the front of the hood 10 thereby eliminating the need of a three-piece mold system for the injection mold process of the hood. This development leads us to the second aspect of the present invention, which is the utilization of a two-piece mold to form a complex molded component.

The second aspect of the present invention, which is the use of a two-piece mold arrangement 50 to form a complex molded component, will now be described. As noted above, complex molded components typically require a three-piece mold arrangement due to the complexity of the component. In the present embodiment the complex molded component consists of a lawn tractor hood 10 however, as previously mentioned, the present invention can be used for any type of complex molded component. The complexity of the lawn mower hood 10 can best be seen from FIGURES 11-16. The hood 10 contains a cavity 12 that extends from the front 100 of the hood 10 to the back 101 of the hood 10. Located near the front 100 of the hood 10 is a C-shaped open cavity 36 as shown in FIGURES 15 and 16. Typically a three piece mold arrangement is required to obtain the C-shaped cavity 36 or parabolic shape as mentioned above. The C-shaped cavity 36 is defined by an overhang 104 located at the top 106 of the hood 10, by an under-hang 108 located at the bottom 110 of the hood 10, and a periphery 124 that circumvents the cavity 36. Located at the rear 112 of the C-shaped cavity 36 is the headlight flange 38 as previously mentioned. The headlight flange further consists of two side sections 114, 115 and a center section 116. The side sections 114, 115 extend further down form the top 106 of the hood 10 than does the center section 116 as best shown in FIGURE 13. The side sections 114, 115 further contain holes 34 to allow installation of the headlights 32 as previously described. As shown in FIGURES 13 and 14 the headlight flange further consists of two supports 118 to provide stability for the headlight flange 38. The supports 118 are operatively attached to the back of the headlight flange 38 and to the underneath side 120 of the top 106 of the hood 10. Referring to FIGURES 15 and 16, the mold required to form such a complex component consists of an upper portion 52 and a lower portion 54. The upper 52 and lower portions 54 of the mold system 50 further consist of contact surfaces 56, 58 that are abutted

against each other when the mold 50 is in the closed position as illustrated in FIGURE 16. The upper portion further contains a runner 51 whereby the molten resin is injected through and into the cavity of the mold. It should be noted that the runner 51 can be in any location of the mold chosen with sound engineering judgment. The lower portion 54 further consists of a top rounded portion 60. The top rounded portion 60 forms the C-shaped open cavity 36 near the front 100 of the hood 30. This can best be seen in FIGURE 16 where the front 62 of the top round portion 60 is visible when the mold 50 is in the closed position. The top round portion 60 of the lower portion 54 further contains slots 53. The slots 53 extend vertically downward and allow the formation of the headlight flange 38, the headlight holes 34, and the supports 118. The headlight flange 38 is shown in FIGURES 11 and 13.

Still referring to FIGURES 15 and 16, in performing the injection mold process, the upper portion 52 and lower portion 54 are abutted against each so that the contact surfaces 56 of the upper portion 52 and the contact surfaces 58 of the lower portion 54 are in contact with each other. In this position the mold 50 is in the closed position as illustrated in FIGURE 16. An injection molten resin is injected through a runner 51 and into the hollow portion 68 of the mold to form a molded resin product while keeping the upper 52 and lower portions 54 abutted against each other. After the resin has cured inside the hollow portion 68, the upper 52 and lower portions 54 are moved away from each other in a direction indicated by the line of draw 64 as illustrated in FIGURE 7. The molded component 66 is then removed from the mold 50 and the process is repeated.

The preferred embodiments have been described, hereinabove. It will be apparent to those skilled in the art that the above methods may incorporate changes and modifications without departing from the general scope of this invention. It is intended to include all such modifications and alterations in so far as they come within the scope of the appended claims or the equivalents thereof.